Regional Sewer System Rate Structure Study

Principal Investigators:

Thomas F. Luce, Jr., Hubert H. Humphrey Institute of Public Affairs
Barbara L. Lukermann, Hubert H. Humphrey Institute of Public Affairs
Herbert Mohring, Department of Economics

Research Assistants:

David Anderson
Steven Gjerstad
Yong Nam Song
Douglas Snyder

December 7, 1992

List of Tables

List of Figures

these cost estimates to a system that assesses a uniform fee per gallon of flow to all municipalities. The use of plant sewer-sheds to determine the baseline configuration of service areas is driven by the fact that water treatment costs represent the bulk of costs in the system and vary significantly plant by plant. The link to Council-defined policy areas and task (3) is achieved by summarizing the cost estimates for municipalities in the developed, developing, and free-standing growth areas of the region.

The social, economic and environmental effects of the alternative fee structures are assessed by examining the likely outcomes in regional housing and labor markets of changing from the current uniform fee structure to one that is based on actual costs as estimated in this work. This discussion relies on two bodies of existing empirical literature and analysis of the development incentives embodied in the alternative fee structures. The relevant empirical literatures examine, first, the effects of inter-local development cost and tax differentials on settlement and employment patterns and, second, the effects of settlement patterns on the costs of providing local and regional public infrastructure. These issues cover the most important social and economic effects of the alternative fee structures.

The fee structure comparisons also speak to two central environmental questions. First, does the overall rate structure reflect the total costs of treating wastes, thereby sending accurate signals to consumers regarding the level of care they should exercise in there use of the collection and treatment services? Second, do inter-local fee differences reflect the fact that different sinks in the region have different capacities to absorb treated waste water? If waste has to be treated to a higher level for one sink than

II. Executive Summary

Objectives

This study examines the economic, social and environmental implications of the fee structure the Metropolitan Waste Control Commission (MWCC) currently uses to allocate the costs of its waste-water-collection and treatment services among municipalities and between present and future users. The analysis is limited to MWCC-owned assets -- nine waste treatment plants and the 600+ miles of interceptor sewers that convey flows from locally operated sewer systems to the plants. The study compares the current level and distribution of charges with the distribution of the costs that present and future users in the various municipalities impose on the system. The cost distribution provides a useful comparison point primarily because a fee structure properly designed to reflect full costs would lead, according to economic theory, to efficient utilization of the region's resources. The comparison also provides a useful starting point for evaluating the costs of alternative fee structures in which considerations of equity rather than efficiency play an important role.

Development Costs, Settlement Patterns, and Public Infrastructure Costs

User fees, like taxes, are part of the total costs of residing or doing business in a particular municipality. Differences among places in user fees, therefore, can affect regional development patterns. Development patterns, in turn, affect the cost of providing regional and local public services such as waste collection and treatment, transportation and education.

plants and, to an even greater extent, sewers. These economies make it efficient when expanding capital plant to cover not just current capacity requirements but also anticipated requirements for a substantial period into the future. Costs must, therefore, be allocated not just among the communities that the MWCC presently serves but also between present and future users. This study finds fault both with the way in which the MWCC measures capital costs and in the way in which it allocates all costs both among communities and between present and future users.

Fee Structures. The MWCC charges a community a fee for its services that is proportional to the volume of wastes disposed by its residents and is independent of which treatment plant processes its wastes and how far the community is from that plant. A fee structure that results in efficiently utilizing the resources which provide waste-water collection and treatment would charge each consumer the marginal cost of serving that consumer, where "marginal cost" is the increment to total costs caused by adding that consumer to the system. In the case of sewage collection and treatment, marginal costs are difficult measure. In addition, if a system is designed to minimize total costs, the presence of scale economies implies that marginal-cost prices would not recover the full costs of providing the service. Average costs are much easier to measure, generate fees that fully recover costs, and, in most cases, are comparable to marginal costs. We therefore use average costs to measure the costs of serving consumers in different municipalities.

Measuring Capital Costs. Although the MWCC regards the respective lives of treatment plants and sewers as being 40 and 80 years, state law limits bond financing to a maximum of 20 years. The MWCC measures this year's "capital treatment differ among them and to contrast this allocation with that achieved by a flat fee per thousand gallons. This study divides costs into several categories. The costs incurred by current users are distinguished from the costs of holding capacity in reserve for future users. Costs in both categories are divided into solids-treatment, liquids-treatment, and interceptor costs. For current users, costs are further separated into capital and O&M (operating and maintenance) categories. Only capital costs are allocated to future users.

Our base calculations make the same assumption as is implicit in the MWCC's allocation of capital costs between present and future users: an asset deteriorates only with age; its depreciation is independent of the intensity with which it is used. Given this assumption, the annual cost of holding one "SAC unit" -- 100,000 gallons per year of an asset's capacity, the amount of sewage disposal services an average household uses -- for a future user is the same as the capital cost a current user imposes by using a SAC unit of the asset. This study's cost allocation scheme treats the cost of holding an asset in reserve for a user as the cost accumulated at interest of a SAC unit for each of the years since the asset was purchased. The connection fee we compute for a new user equals this cost summed over all assets held in reserve on the user's behalf.

We calculated costs for current and future users separately for each of the MWCC's nine treatment plants.[1] Liquid treatment costs and all O&M costs that could be traced to a specific plant are allocated directly to it. For

[1] [illegible]

resulting excess consumption increases the long run costs of providing services -- and of protecting the region's environment.

The study's connection-cost estimates also reveal that current MWCC revenues from service availability charges (SAC fees) are less than the full costs of holding capacity for new users. The average difference is about $270 per SAC unit -- the rough equivalent of the present value of the annual user cost subsidy. However, our connection cost calculations, particularly for interceptors, must be viewed with some caution. Problems with data reliability and the sensitivity of results to assumptions about asset lifetimes and ages make these estimates less reliable than those for current users.

Cost Variations across Plant-sheds. The cost of serving current users varies substantially among the nine plants. Costs vary from a low of about $112 per 100,000 gallons per year at the Metro plant to a high in excess of $250 at Hastings. Much of this variation relates directly to plant capacities; significant economies of scale exist in the current system. Unit costs decrease by more than ten percent with each doubling of plant capacity. The largest plant -- Metro with a daily capacity of 250 million gallons -- has unit costs that are less than 45 percent of those of the smallest plant -- Rosemount at 72,000 gallons per day.[4]

Interceptor costs for current users also vary significantly across the region. A few communities use no interceptors; Anoka, which uses about 38 miles of interceptors, incurs the highest cost -- $25 per 100,000 gallons. However, interceptor costs are a small fraction of plant costs. The system-greater than the average, the long-run cost implications of the settlement patterns that result from a uniform fee system are potentially significant.

Costs allocable to future users -- connection costs -- also vary greatly across plant-sheds from a low of $392 per SAC unit in the Empire plant-shed to a high of roughly $2,500 for Hastings. In general, connection costs are lower than average in the plant-sheds with the newest capital stocks -- Empire, Seneca, Blue Lake, and Rosemount -- roughly at the mean for Metro and Stillwater, and above average at the older, small plants -- Chaska, Cottage Grove and Hastings. Again, however, data problems and the sensitivity of calculations to changes in assumptions make these estimated differences less reliable than those for current user costs.

Cost Variations across Policy Areas. Most of the Developed Area is served by the most cost-effective plant in the system, Metro. As a result, a uniform fee generates subsidies from the Developed Area to the Developing and Free-standing Growth Areas.

While modest -- $13 per household per year -- the cost to the Developed Area of a uniform fee that would cover full system costs translates into a potentially significant total dollar flow out of the Developed Area -- more than $6 million per year. Minneapolis and St. Paul bear most of this cost -- more than $2.75 million a year in each city.[3]

On the receiving end, many municipalities in the rest of the region benefit significantly from these transfers. Twenty municipalities primarily in the southern and western parts of the region would receive subsidies with present values of between $1,000 and $3,700 per household under a uniform fee

III. Literature Review

Two categories of research on location costs and decisions are relevant for this work. First, there is a large body of work examining the extent to which differences across communities in tax rates and other publicly generated costs (such as user fees) affect settlement patterns. Second, there is a small group of studies examining the public infrastructure costs associated with different development patterns. The central issue in much of this work is how costs vary with the density of development.

A. The effects of development cost differentials on location decisions

There is a large empirical literature that examines the effects of local fiscal policies on the location decisions of firms and households. Much of this work concentrates on taxation, especially local property tax differentials. However, the findings are relevant in evaluating the implications of infrastructure pricing as well. A dollar is a dollar and differentials in user fee rates across municipalities should affect location decisions in much the same way that tax differentials do. This is particularly true if, as is the case with the MWCC, fee differentials reflect differences in the costs of providing services rather than differences in the level or quality of service. Since the MWCC provides essentially the same service to all parts of its service area, fee differentials represent pure cost differences to individuals and businesses. These cost differences are not offset by differences in the benefits from the provided service.

The work in this area is logically divided into two categories: employment location decisions and household location decisions. The other attributes of places that may tie jobs to specific locations (such as proximity to regional or national transportation links). However, the general implication is clear -- cost differentials matter to businesses when they decide where to locate within a metropolitan area.

In general, sewer fees charged to municipalities by the MWCC are smaller in magnitude than property taxes. This means that a 1 percent change in fees represents a smaller cost change than a 1 percent change in property taxes. A 1 percent fee change should therefore translate into a proportionately smaller employment change. However, the differential between sewage fees and property taxes is not so large as to rule out significant effects. MWCC sewer fees are roughly $100 per household per year in the region while total property taxes in a typical inner ring suburb would normally be in a range from $1200 to $2600 per household per year.[9] If user fees affect costs in roughly the same way that taxes do, this implies an elasticity of employment relative to sewer fees between -.07 and -.15. This means, for instance, that if the user fee in a community rose by 20% relative to its neighbors then employment would be expected to decline by 1.4% to 3.0% in the long run -- magnitudes great enough to be of interest to many localities.

The empirical literature regarding the effects of tax or user fee differentials on household location is less helpful for this work. In contrast to the employment-location literature, there has been very little work done which directly estimates the effects of tax/user fee differentials within metropolitan areas on population growth at the local level. The

---

[9] For example, total 1990 city, county and school district property taxes in

thus a combination of lower prices for housing and fewer housing units in the community. The mix between the two effects depends on the sensitivity of supply and demand to price changes.

Because the ultimate mix of price and quantity effects depends on the nature of supply and demand, it is likely that the final outcomes of tax/fee changes will vary from place to place. For instance, in an exclusive, high amenity suburb where new construction is tightly regulated, one would expect a fee increase to translate into changes in housing costs for the most part, because the quantities demanded and supplied would both be relatively insensitive to price. On the other hand, in a more typical suburb which contains some undeveloped land and which competes for residents with many similar (and nearby) places, demand and supply are both likely to be very price-sensitive, meaning that fee changes are likely to translate primarily into quantity (location or density) changes. Finally, in a very diverse community (such as a central city), one would expect to see different types of outcomes in different housing sub-markets. For housing types that are unique to the central city -- such as high-end housing close to urban amenities or low-end housing which is largely absent from suburban areas -- price effects would dominate. For housing types that are not unique to the central city -- middle income housing for instance -- quantity effects would be more important.

As noted above, there is very little empirical work examining the sensitivity of housing demand at the local level to price (the primary determinant of the extent to which fee changes will translate into quantity effects). This is largely the result of methodological problems and a out-of-pocket expenses would be to reduce this difference. Thus, continuing to assume a 4% real rate of interest, the present value of $100 a year in sewer charges is $100/.04 = $2,500. A 50% increase in this fee would increase its value by $1,250. Since, by assumption, all other communities in the metropolitan area have not been affected by the sewer price change, the area-wide housing market will force the small community's home owners to bear this sewer cost increase in the form of a reduction in their property values. In the very short run, this windfall loss would be the only effect of the fee increase.

Over the longer run, however, a $1,250 fee increase would induce a $1,250 fall in the value of a house's worth of land. Such a price reduction would result in the substitution of land for capital in the production of housing services. A less dense community with lower total population would result. To get a rough idea of the magnitude involved, on average about 25% of the value of a house is accounted for by the land it uses -- $25,000 of land for a $100,000 house. $1,250 is 5% of $25,000. A 5% reduction in the price of land would result in about a 5% increase in the amount used per house and, hence, in about a 5% reduction in population density.

B. <u>Development patterns and public infrastructure costs</u>

This literature examines how various community characteristics, particularly density, affect the costs of providing public services. Of particular relevance for this report is the work that investigates how settlement patterns affect the cost of providing sewer services.

5. Total annual cost.

Findings: Full Capital costs ranged between $27,224-33,024 per new dwelling unit as "systematic effects of variations in":

> Characteristics of population--students per dwelling and ratio of private to public schools municipal standards--20-25 v. 40-45 pupils per class (This plus students per household led to difference between $8,578/pupil in Newton and $16,905 in Wayland). 22-foot unpaved ($81 per house) v. 29-foot paved streets ($162 per house)
>
> Lot size--septic tanks for 20,000 ft^2 lots cost $1,418 while largest sewer cost was $7,671. water system costs ranged between $2,471-$5,808
>
> Precipitated direct capital costs ranged between $15,682-$23,798.

(Precipitated cost reflects actual capital outlay; full capital cost includes allocation of costs of existing facilities.) Going from 30,000 ft^2 lots with 150 foot fronts to 10,000 ft^2 lots with 80 foot fronts in Natick reduced precipitated primary costs by $1,400. The total variation attributed exclusively to lot width was $1,400-$2,000 while differences in standards yielded variations of $1,500-$2,100. Precipitated secondary direct costs ranged between $543-$9,242.

Conclusion: For builders, costs do not vary much with location. Municipalities, though, should be sensitive to variations in indirect capital costs which can precipitate major cost differences.

Isard and Coughlin (1957).[15] The study estimated costs borne by a municipality exclusively for things on a development site except for sewage which was estimated as part of 16,000,000 gal/day treatment plant serving area with 200,000 people. Capital costs for roads, sanitary and storm sewers, and schools ranged between $17,467 and $24,041 for 16 and 4 dwelling units per acre respectively. Capital outlay for one dwelling unit per acre were $18,245

Stone (1973).[18] Findings: An increase from 9 to 29 dwelling units per acre resulted in an increase from $10,919 to $16,677 in building costs per capita and a decrease from $1,273 to $482 in development costs per capita or from about $4,417 per household to $1,648.

Real Estate Research Corporation (1974).[19] This study incorporated as costs: Schools, streets (arterial, collector, and minor), police, fire, sewers, storm drains, water supply, gas, electricity, telephone, other. Costs are cited for mixes of dwelling types and range between $20,000-$40,000 from least to most expensive mix. Costs were evaluated for 1,000 dwelling units of six densities:

> Single family conventional: 1,600-ft^2 houses on 14,000 ft^2 lots for a net density of 3 dwelling units/acre and neighborhood density of 2.5 dwelling units.
>
> Single-family clustered: 1,600-ft^2 on 8,700 ft^2 lots with curvilinear street pattern and much more public open space net density of 5 dwelling units/acre and neighborhood density of 2.5 dwelling units per acre.
>
> Townhouse clustered: 1,200-ft^2 attached in groups of 5 on curved streets with ample recreation space--15 dwelling units/acre and neighborhood density of 10/acre.
>
> Walk-up apartments: 1,000-ft^2 units at 15/building with curved streets and ample recreation space--15 dwelling units/acre and neighborhood density of 10/acre.
>
> High-rise apartments: 900 ft^2 units in 6-floor buildings for 30 dwelling units/acre and neighborhood density of 10 units/acre.

Windsor (1979).[20] This study recomputed costs from Stone (1973) to hold floor space and pupils per household fixed. These changes reduced cost

---

[18] Stone, P. A., The Structure, Size, and Costs of Urban Settlements, Cambridge, UK: Cambridge University Press, 1973.

[19] Real Estate Research Corporation, The Costs of Sprawl: Detailed Cost Analysis, Washington, DC:US Government Printing Office, 1974.

Fagerlund (1979).[5] This work is especially pertinent to the analysis of interceptor costs. Fagerlund's objective was to build a model to aid in minimizing the costs of providing sewer service to an area and to determine the extent to which the marginal and average costs of providing service vary with settlement patterns and the temporal and spatial layouts of pipe systems. He determined the cost of an optimally staged pattern of government services but not the interaction between the location decisions of households and developers on the one hand and the investment plans of service providers on the other.

Fagerlund described the technology of collection systems and optimal pipe design but did not deal with optimal two-dimensional layouts of pipes; he assumed, rather, that interceptors are designed only to connect exogenously specified nodes, one in each individual zone. Fagerlund took it as given that a cost-minimizing pipe system is one with sufficient capacity to serve the ultimate population of an area up to 50 years in the future and that treatment plants should be designed for anticipated demand 25 years in the future. The elasticity of the capital costs of a treatment plant with respect to its capacity is approximately 75%. He cited information that there are substantial scale economies in the provision of sewer services. There appears to be a general belief among engineers familiar with sewer construction that a doubling of a sewer's capacity requires only about a 10% increase in its costs. Fagerlund cited information suggesting that the capacity of a sewer line increases with the 0.375-power of its diameter. He assumed, however, that costs are proportional to the square root of capacity—the proportion providing public services because these costs are negatively related to the density of residential and business structures in a community. According to one study, in 1987 dollars, the costs of 27-foot wide streets, curbs, sidewalks, storm and sanitary sewers, catch basins and culverts, and water supplies, averaged about $100 per front foot for a dwelling.

The distance between a community and the facilities that provide it with fresh water and with waste-water collection and treatment have a substantial effect on the costs of delivering these services; one study estimated annual and capital costs of $90 and $1960 for water, drainage, and sewage per household per mile of separation in 1987 dollars.

interceptor segments for which we had complete information yielded[24]

$$\text{Cost} = A \cdot (\text{Length})^{0.78} \cdot (\text{Capacity})^{0.35}$$

In designing a cost-minimizing sewage collection and treatment system, a balance must be struck between scale economies in the provision of sewage treatment services and scale diseconomies in collecting the sewage to be treated. The larger is the treatment plant, the lower are its unit costs. At the same time, however, the larger is the plant, the greater is the average distance from which sewage must be brought if the plant's capacity is to be fully utilized. While scale economies in sewer provision limit the costs of greater distance, they do not eliminate them. This being the case, it is unwise to consider sewer and sewage treatment costs in isolation. A small treatment plant will almost inevitably have higher treatment costs than a large plant but also almost inevitably will have lower costs of transporting the sewage to be treated.

A fundamental proposition of economic theory is that setting price equal to marginal cost is a necessary condition for achieving an efficient allocation of an economy's resources. There are, however, two serious problems with marginal-cost pricing when increasing returns to scale are present. First, with scale economies, marginal cost prices will not, as a general proposition, generate revenues sufficient to cover the total costs of an optimal system. Second, marginal costs are difficult to define and calculate in complex systems. This is especially the case for the interceptor system.

---

[24] Cost is in dollars per year, capacity is in million gallons per year, and length is in feet. The t-statistics on these parameter values is highly significant---11.06 for length and 14.40 for capacity. Despite its goodness-of-fit measure, however, the exponent on length should be viewed cautiously.

carrying their flows that reflects their share of capacity.

This distance-based fee structure is not without problems. The location of treatment plants is, to some degree, arbitrary. Locations are limited, of course, by the availability of sinks. But where on a particular river a plant is located is discretionary to some extent. Facility locations may also change after many consumers have already made location decisions. Alternative locations for an interceptor that leave total system costs unchanged can alter substantially the costs of serving individual communities. These issues deal essentially with the fairness of the system and are not appropriately in the domain of this study.

B. Measuring Capital Costs

In general, we have reservations about the way in which the capital costs of sewage transportation and treatment are accounted for in MWCC records and about how they are allocated to the Commission's present and future customers. Were our reservations to be taken into account in the Commission's pricing procedures, it is likely that it would charge more for its services generally, although not necessarily to all of the classes of its customers that can be usefully enumerated. The Commission's operations would be "profitable" thereby generating net revenues that could be used to offset the operating costs of the Metropolitan Council or, more broadly, Metropolitan Area governments. Higher prices would induce more careful use of wastewater collection and treatment services thereby reducing required capital spending in future years.

The primary reservation regarding current practices involves the way local debt service costs would lead to decisions regarding the mix of inputs (capital, labor ....) that are likely to be inefficient in the long run, both from a local and a national point of view. Using an under-estimate of capital costs would also distort the determination of access fees for new users.

The second problem with the current procedure is that it allocates the cost of assets incorrectly over time. To an economist, the value of an asset is equal to the value of the flow of services that it generates. A measure of the asset's cost should reflect the fact that an alternative use of the money could generate a stream of services of equal, or nearly equal, value. These foregone returns represent the full cost of the asset. As the Commission uses the term, however, annual "capital costs" are the annual outlays required to service its bonded debt--payments for interest and to retire maturing bonds. The bonds issued to finance the Commission's investments are set up to recover total costs in 20 or fewer years, periods that are substantially shorter than the expected service lives of most Commission investments (40 - 80 years). This means that a fee system based on debt service costs results in "early" users of a given asset subsidizing "later" users. Given the different timing of asset acquisition in the current system, it would be extremely difficult to evaluate whether the subsidies received by current users from past users outweigh their subsidies to future users. Basing fees on direct measures of total capital costs spread over the full life-time of assets avoids this problem.

The third problem is that, according to MWCC staff, tracing debt service costs to specific locations would be extremely difficult, if not impossible. Estimating capital costs directly from asset values allows us to trace costs

These costs depend on (1) how long the capacity is held idle; (2) the outlay required to produce this capacity; and (3) how the assets depreciate: through wear associated with use, through aging that is independent of use, or both.

The role of the first two considerations is straight forward. The longer an asset is held idle and the greater is its initial cost, the larger is the appropriate connection fee.

The third consideration -- the causes of depreciation -- is more complicated. The two extremes and an intermediate case illustrate the issue. At one extreme is an asset with a life that depends only on calendar time, not on how intensively it is used. Well-maintained sewers come close to this extreme. A stream of annual payments over the life of such an asset can be determined that had a present value when the asset was acquired equal to its cost of construction. Dividing the payment for a given year by the asset's capacity yields the appropriate annual charge for each unit of capacity. This charge is appropriate, it should be emphasized, for units that are held in reserve for future users as well as for those that are currently in use. Current users pay currently for the units they presently use; future users should pay the charges for idle capacity effectively incurred in their behalf plus accumulated interest at the time they tie into the system.

At the other extreme is an asset that depreciates only with use--an asset that would have an infinite life if held idle. Holding a unit of such an asset's capacity for a future user does not diminish the stream of services that the asset will ultimately deliver. Users should be entirely responsible for covering the costs of such an asset; *when* a user enters the system has no effect on the costs that user imposes--only use imposes costs.

depreciation of an asset depends on time rather than use, once the asset has been built, capacity that goes unutilized until several years after construction imposes the same costs on the system as immediately utilized capacity. Encouraging orderly growth reduces system average costs by reducing unutilized capacity. The pricing system arising out of our analysis provides an inducement to early development by imposing connection fees that increase with the time that has elapsed since construction of the assets being put into use.

debt service, plant costs, and interceptor costs. Industrial strength charges were excluded because they are not included in the fees charged to municipalities.[27] Debt service was excluded because capital costs were calculated directly from MWCC-2 (see below).

MWCC-2 was the primary source for treatment plant capital costs. For assets acquired since 1970, the costs shown in this source were assumed to represent the full construction costs of the assets at the time they came into use. Current valuations were derived by inflating the data to 1991 dollars using the acquisition date and cost indexes for sewer and for fresh-water treatment plant construction derived from Construction Reports, Series C-30, Bureau of the Census.[28]

Values for assets purchased from municipalities in 1970 were computed from BV. The Black and Veatch study estimated asset values by deducting grants and outstanding debt from construction costs, inflating the result to 1970 dollars, and then adding outstanding debt back in. This procedure does not provide an estimate of full costs. Values shown for these assets in MWCC-2 are therefore not consistent with those shown for later acquisitions. 1970 values for the purchased treatment plants were estimated by inflating the year-by-year investment data shown in Section II of BV to 1970 using the same

---

[27] Due to data limitations, we have no way to isolate the expenditures associated with treating industrial waste from those associated with residential and commercial users. All comparisons of actual fees with our cost estimates, therefore, assume that industrial strength fees cover the full costs of treating industrial waste. Discussions with MWCC staff suggest that this is an issue worthy of a study in itself.

[28] Cost indices for the construction of sewers and of waste-water treatment plants were developed by the Environmental Protection Agency for the period prior to 1982. The EPA sewer index is reasonably consistent with that of Construction Reports. Similarly, the EPA index for waste-water-treatment

according to each jurisdiction's share of total flows into the relevant plant. (3) Solid waste treatment costs were allocated to municipalities by the same procedure for municipalities in the Seneca and Empire watersheds.[31] Solid treatment costs at the Metro plant were allocated to all other municipalities according to their shares of the total flow from all of those municipalities combined. (4) System-wide administrative costs were allocated to municipalities according to their shares of total flows in the system.

Capital costs were allocated to municipalities in four steps. (1) Assets were divided into solid and liquid treatment categories. This was done through the asset descriptions from MWCC-2 and consultation with MWCC staff. Assets that could not be attributed unambiguously to one category or the other were distributed using the 40/60 rule applied to O&M costs. (2) Annual capital cost was computed for each asset. Annual cost was defined as the annual expenditure stream needed to finance the 1991 dollar value of the asset over its lifetime at a 4% real interest rate.[32] (3) Annual capital costs were summed within the treatment plants and the future user portion of costs was subtracted. This portion was assumed to be the percentage of plant capacity that was idle during 1991. (4) Annual capital costs for solid and liquid treatment were allocated to municipalities by a procedure identical to that used for O&M costs.[33]

---

[31] The limited number of assets at the Blue Lake plant that are designated for treatment of solids were allocated to municipalities in the plant-shed in the same manner and added to the costs associated with shipping solids to the Metro Plant.

[32] The discount rate for this calculation should correspond to the long-run real interest rate (nominal interest rate minus the inflation rate). 4% is a typical level for this indicator during the last 30 years.

[33] Independent estimates of the replacement cost of the nine plants that

asset i at plant j. (2) The future user portion of the cost for each asset was computed as the product of the proportion of plant capacity that was idle in 1991 ($XCAP_j$) and C_{ij}. (3) The total discounted value of the annual cost from step (2) over the actual age of the asset (y_{ij} = 1992 minus the construction date) was computed by $[(XCAP_j*C_{ij})/r] * (e^{ry}-1)$, where $r = .04$ (the estimate of the long-run real rate of interest). These values were then summed across all assets in the relevant plant. And (4) this sum was translated into cost per 100,000 gallons per year by dividing by 1991 excess capacity (measured in units of 100,000 gallons) at the relevant plant -- $(XCAP_j*CAP_j)$.

D. <u>Findings: Plant Costs Assuming That Time Alone Contributes to Depreciation</u>

Tables 1 and 2 show the results of the cost calculations under the baseline assumption that all depreciation is attributable to aging (and none to use). Table 1 contains estimates of cost per 100,000 gallons broken out by plant for liquid and solid treatment, O&M and capital costs, and system costs.[34] Also shown are total costs as a percentage of the system-wide average and total 1991 flows through the plants.

The treatment cost estimates reveal several points of interest. First, the current charge structure does not recover the full costs of the system when the more complete definition of capital costs used in this work is substituted for debt service expenses. Actual charges to municipalities in 1991 averaged $106 per 100,000 gallons. This was less than our estimate of the average cost for plant services alone ($113.50). This "deficit" will, of course, increase when interceptor costs are included in the analysis and discussion of this issue is left for sections VII and VII.

Second, the Metro plant is easily the most efficient plant in the system. It's costs are nearly 10% lower than the system wide average and roughly 25% lower than the second most efficient plant. This means that with a uniform fee system covering the full costs for treatment plant services, users in the metro plant-shed would be subsidizing other users in the system by about $10 per 100,000 gallons per year (the difference between Metro costs and the system-wide average). However, because Metro serves such a large proportion of the system's total flow, these relatively small subsidies would translate into substantial subsidies for users in the rest of the system, especially those in the smallest plant-sheds. The subsidies range from $20 per 100,000 per year to Seneca plant users to $207 per 100,000 gallons for Rosemount users.[15] (It is important to note that these estimates represent the subsidies that would exist with a uniform fee covering full costs, not the subsidies generated by the current fee system. Under the current system, Metro users essentially pay full costs while the benefits of past federal aid are distributed to all other users in amounts reflecting cost differences and usage.)

Third, the data show clear economies of scale in treatment facilities. The cost and subsidy measures vary closely with plant capacities and actual plant flows. A very simple estimate of the relationship implies that if plant

---

[15] The unit cost estimates for the Stillwater and Rosemount plants should be regarded as lower bounds. Expanded capacity was available at Stillwater in 1991, but the capital costs associated with the expansion were not yet included in MWCC-2 because the expansion was not completed at that time. For

Table 2

1991 Connection Costs by Treatment Plant

Capacity Mgal /Day	Prop. Excess Capacity	Avg. Age of Assets		Capital Cost/100Kgal/yr			Discounted Cost/100Kgal of holding capacity thru 12/91		
		Liquid	Solid	Liquid	Solid	Total	Liquid	Solid	Total
250	0.12	12.6	9.4	18	15	34	344	341	685
34	0.33	3.1	11.7	36	8	44	155	188	343
32	0.30	4.8	5.2	38	19	57	265	360*	625
9	0.34	2.9	6.8	50	18	68	138	191	329
4.50	0.29	26.8	9.4	14	15	29	734	341	1,075
2.34	0.32	10.4	9.4	99	15	114	2,137	341	2,478
1.80	0.12	20.6	9.4	37	15	53	1,321	341	1,662
1.66	0.02	10.8	9.4	65	15	81	1,182	341	1,523
0.72	0.13	1.9	9.4	84	15	113	172	341	513

mputed as the weighted (by value) average of the ages of assets listed under the plant. Ages of red in 1970 were estimated in similar fashion from the stream of investments reported Location and nd Current Value Apportionment of Interceptors and Treatment Works: Metropolitan Sewer Service Region, ch, 1971. Discounted costs per 100 Kgal for acquired assets were also computed using the stream of in the plants reported by Black & Veatch. For all other assets, ages and costs are from MWCC Fixed ory: 9-1-92.

alue = $\sum_i \{[(XCAP_j * C_{ij})/r] * (e^{ry_{ij}}-1)\} / (XCAP_j * CAP_j)$.

capacity proportion at plant j; C_{ij}=cost/yr of asset i at plant j (1991$), r=.04, yij=age of asset i at CAP_j=capacity per year in 100Kgal of plant j.

atment capacity is currrently being developed at Blue Lake. Cost estimates include costs of assets at ke and Metro (where Blue Lake solids are currently shipped).

E. Findings: Plant Costs Assuming that Time and Use Contribute to Depreciation

As noted in Section IV.D, current MWCC pricing practices (as well as the calculations in the previous three sections) assume that only aging is responsible for the depreciation of plant infrastructure. Use is assumed to have no effect on the expected lifetime of assets. This section repeats the basic cost calculations shown in Tables 1 and 2 under the alternative assumption that time and use contribute equally to depreciation of treatment plant assets and that use of the asset increases linearly over time from zero utilization when it is new to 100% utilization at the end of its lifetime.

The derivation of these alternative cost estimates is considerably more complicated than for those reported in the previous three sections and may still contain conceptual flaws that overstate the extent to which costs currently treated as part of SAC fees should be shifted to current users. A full description of the methods is therefore not covered in this section. Appendix A reports the mathematics underlying the calculations.

Table 3 reports the alternative estimates of costs attributable to current and future users and the size of the change from the findings reported in previous sections. The results reinforce several conclusions from the baseline calculations. First is the conclusion that the current user-fee structure understates the costs that users impose on the system. Allowing use as well as time to contribute to depreciation shifts a significant portion of the capital costs previously assigned to future users onto current users. The implied user fee increase is 32% for the system as a whole and the appropriate connection fees are cut roughly in half.

The finding that Metro users are subsidizing users in other plant-sheds current user cost estimates for different plants -- the proportional increases in estimated costs range from 20% to 36%. The increase for the Metro plant is 28% which is less than the average for the whole system. The implied net subsidy from Metro users to the rest of the system increases by 70%, from $10 per 100,000 gallons to $17 per 100,000 gallons. The changes in the net subsidies into the other plant-sheds vary from a decrease in the Stillwater plant-shed (from $23 per 100,000 gallons to $13 per 100,000 gallons) to significant increases for Hastings and Rosemount (from $143 per 100,000 gallons to $198 per 100,000 gallons and from $114 to $172, respectively).

The proportional change in the connection fee estimates is much more uniform than for user costs. There is a spread of just six percentage points, from 48% to 54%. Since we have no strong evidence supporting a particular allocation of depreciation costs to time and use, we cannot say that these cost measures are unambiguously more accurate than the prior estimates. However, it seems reasonable to suppose that use rates do play some part in the depreciation rates of treatment plant assets. These alternative estimates clearly reinforce the findings from the previous calculations that (1) user fees are currently too low and (2) a uniform fee structure for plant services generates subsidies from Metro plant users to users in the other plant-sheds.

data for each segment were inflated to 1991 dollars by the same procedure used for plant assets (described in section V.B).[38]

(2) The 1991 dollar cost estimates were then matched with pipe characteristic data from GIS-1. The GIS-1 data break the pipe system into roughly 3380 segments. Location codes from the two files were used to match the many short segments in GIS-1 to the corresponding 230 longer segments in MWCC-3. A single MWCC-3 segment might contain several GIS-1 segments, each with different characteristics such as capacity, length or building material. For our purposes, the important variables were length and capacity. Lengths for the 230 MWCC-3 segments were computed by summing the lengths of the relevant shorter segments from GIS-1. Capacities (measured in millions of gallons per day) for the 230 MWCC-3 segments were estimated by using the maximum capacity from the relevant shorter segments. Since flow from more than one municipality may feed into one of the longer segments, capacity at the downstream end of the segment is the best summary indicator of its overall capacity. We, therefore, assumed, in effect, the highest-capacity segment of the interceptor to be at its downstream end.

(3) Annual capital cost estimates were computed for each of the 230 MWCC-3 segments with procedures described in V.B.[39] The cost estimates were in units of dollars per year per 100,000 gallons of total capacity. The cost

---

[38] For a limited number of interceptors that were acquired in 1970, BV calculations of construction costs and dates were replaced with estimates that controlled for the time profile of investments in the interceptors. BV used a simple averaging procedure that provided distorted estimates for some of the older and larger interceptors in the system. The revised estimates used weighted (by value) averages.

[39] An estimated annual cost per 100,000 gallons was used for several

of this assumption are most notable in the Empire and Seneca plant-sheds. The relatively small scope of these plant-sheds means that the majority of the municipalities both contain (or border on the place that contains) the treatment plant and represent endpoints for interceptor segments. Nearly all of the municipalities in these plant-sheds were, therefore, assigned the costs of the total interceptor mileage within their borders.

(6) The interceptor connection fee for an individual municipality was computed in identical fashion by summing the appropriate estimates from (4).

This procedure generated a small group of segments with very high relative connection cost estimates. A group of seven segments showed costs in excess of $450, with a maximum of $1,250. Excluding the outliers, the mean connection cost estimate for the 230 segments was $57. The problem segments are highlighted in Figure 1. Four of the seven are very old interceptors in the inner part of the system which serve a large number of northern and western suburbs. The extreme age of these segments were responsible for the high costs. In these cases, the fact that the segments have exceeded (or nearly exceeded) the estimated lifetime of interceptors (80 years) clearly justifies treating the connection cost estimate with caution. An alternative estimate that deleted the costs for the outlier segments was computed for the affected municipalities.

The other three extreme values were for interceptors serving (1) Orono and Minnetonka Beach (at $1,250, the highest estimate), (2) Golden Valley, New Hope and Crystal, and (3) Osseo. These outliers appear to be the result of very high construction costs.[10] In two of the cases, the presence of a lift

were the

station may be affecting the data in unusual ways. It is more difficult to justify "correcting" the cost estimates for the affected communities in these cases. If the construction cost estimates for these segments are indeed accurate and due to factors such as terrain or soil conditions, then the fundamental logic of our cost estimates would warrant counting the full costs. However, the values are extreme enough to provoke doubt about the accuracy of the data. The affected municipalities are treated in the same way as those affected by the very old segments.[4]

There was a second group of seven interceptors which generated connection costs between $250 and $450. They are highlighted in Figure 2. All of these are old segments in the inner part of the system. With one exception, they do not affect a large number of municipalities. In addition, they affect municipalities where the averaging procedure used to account for multiple possible paths through the system dampens their effects on the cost estimates. These segments were therefore treated in the usual fashion and are not noted in the tables.

The exception in the second cluster of segments is the main interceptor that runs from the Mississippi River through central St. Paul to the Metro plant (interceptor 1-MS-100). It affects the connection cost estimate for all

---

[4] This modified estimate, of course, over-corrects for the problem. The alternative cost estimates should, therefore, be viewed as a lower bound. Given the extreme levels of the connection cost estimates for the problem segments, we assume that an alternative procedure that controlled for the age and data problems more rigorously would generate municipality-level cost estimates closer to this lower bound than to the estimates that include the original, inflated, estimates for the problem segments. In general, we have less confidence in the reliability of the data underlying the interceptor cost calculations than for the plant data. It was not possible to completely verify the cost data from MWCC-3 with cross-checks to MWCC-2 or BV because the data were not reported in the same way across the three sources. These [illegible] concentrated in the data for the older assets in the system. [illegible] for the connection cost calculations [illegible] current user cost

of the Metro plant-shed west of the Mississippi. However, it is the lowest cost interceptor in the group, at roughly $270, and is, therefore, not given special treatment. If its relatively old age is of concern, then the affected estimates could reasonably be adjusted by the estimated cost of $270.

Interceptor O&M costs (from MWCC-1) were allocated to municipalities according to the gallon/miles of the interceptor system used by each community. Gallon miles were computed by summing the lengths of the appropriate segments and multiplying by the municipality's total flow.

C. <u>Findings: Interceptor Costs</u>

Table 4 shows the results of the interceptor cost calculations for current and future users. Since the length of interceptor used by a community was such an important factor in the calculations, these estimates are also shown. In all cases, costs are measured per 100,000 gallons per year.

The average total current user cost estimates imply that interceptorcosts are less than 10 percent of total treatment costs -- $9.33 per 100,000 gallons per year compared to $114.[41] However, the cost estimates show a wide degree of variation, creating the potential for significant subsidies in a uniform fee structure. The plant-shed averages vary from $0.00 for the plant-sheds with no interceptors to $13.54 for Blue Lake. The Metro plant-shed shows average costs surprisingly close to the over-all average -- $9.44 versus $9.33. Given that it is the plant-shed at the extreme end of the plant-size versus interceptor-length trade-off, it might be expected to show higher relative interceptor costs. However, a very high proportion of the

---

... of roughly $7.50 per 100,000 ... $2.50 per

Table 4 (cont.)

	Interceptor Miles used	Current User Costs O&M	Current User Costs Capital	Current User Costs Total	Connection Cost 1	Connection Cost 2
Roseville	18.5	6.00	5.60	11.60	422	
Shoreview	22.7	7.36	6.80	14.16	800	374
South St. Paul	5.1	1.67	2.19	3.86	66	
Spring Lake Park	23.6	7.67	7.95	15.62	1,239	388
St. Anthony	13.6	4.43	1.96	6.39	269	
St. Louis Park	21.1	6.84	4.55	11.39	802	247
St. Paul	3.3	1.07	1.55	2.62	225	175
St. Paul Park	7.2	2.33	3.85	6.18	113	
Vadnais Heights	18.9	6.12	11.26	17.38	397	
West St. Paul	9.1	2.95	1.36	4.31	202	
White Bear Lake	22.2	7.22	6.08	13.30	307	
White Bear T	20.6	6.67	10.38	17.05	335	
Willernie	15.2	4.92	3.43	8.35	150	
Woodbury	7.2	2.35	2.37	4.72	118	
Seneca	13.4	4.60	3.22	7.82	91	
Bloomington	12.8	4.15	3.98	8.13	164	
Burnsville	22.0	7.16	3.48	10.64	112	
Eagan	10.1	3.29	1.85	5.14	67	
Savage	8.8	2.87	1.48	4.35	20	
Blue Lake	20.4	6.26	7.39	13.65	323	219
Chanhassen	14.8	4.80	4.17	8.97	59	
Deephaven	13.2	4.29	5.62	9.91	199	
Eden Prairie	13.3	1.09	1.14	2.23	16	
Excelsior	14.3	4.65	6.61	11.26	236	
Greenfield	24.3	7.90	13.03	20.93	319	
Greenwood	12.4	4.02	5.49	9.51	197	
Independence	24.3	7.90	13.03	20.93	319	
Laketown T	24.7	8.02	7.88	15.90	150	
Long Lake	20.6	6.67	10.95	17.62	303	
Maple Plain	24.3	7.90	13.03	20.93	319	
Minnetonka Beach	24.7	8.03	10.07	18.10	1,508	263
Minnetonka	16.9	5.64	6.83	12.47	234	
Minnetrista	25.2	8.18	9.42	17.60	201	
Mound	27.0	8.75	7.77	16.52	218	
Orono	25.5	8.26	12.81	21.07	1,557	311
Prior Lake	11.0	3.55	0.35	3.90	10	
Shakopee	9.1	2.94	3.02	5.96	101	
Shorewood	15.9	5.31	11.76	17.07	127	
Spring Park	23.6	7.67	5.40	13.07	99	
St. Bonifacius	22.8	7.42	5.08	12.50	81	
Tonka Bay	15.8	5.13	5.64	10.77	217	
Victoria	21.2	6.88	6.83	13.71	131	
Waconia	28.2	9.15	8.70	17.85	167	
Wayzata	17.0	5.51	7.12	12.63	246	
Empire	9.5	3.91	3.81	7.72	78	
			3.87	7.30	114	
					36	

users of the Metro plant are clustered relatively close to the plant and the weighted average for the plant-shed (with flows determining the weights) reflects this. The age of the capital plant does not have a great deal of influence on the inter-plant-shed comparisons. Metro's relatively older interceptor system does not generate annual user costs significantly higher than the newer systems in the Seneca, Blue Lake and Empire plant-sheds.

There is also a great deal of variation within plant-sheds. For the most part, the variations reflect differences in the distances from municipalities to the relevant plants, rather than differences in capital costs per mile. For instance, Anoka shows both the most miles of interceptor usage (37.7 miles) in the entire system and the highest current user cost ($25.28 per 100,000 gallons per year). In some cases, however, variations in capital cost per mile are an important factor. This is especially true in the Blue Lake plant-shed. For instance, Waconia and Mound show the greatest usage in miles of interceptor in the plant-shed (28.2 and 27.0 miles respectively) but their total costs per 100,000 gallons per year are only slightly above the average for the plant-shed.

As described in VI.B, two interceptor connection cost estimates were computed. Both are shown in Table 4. The first column of estimates shows the degree of distortion caused by the seven outlier segments. The range of connection costs within the Metro and Blue Lake plant-sheds (the two affected areas) exceed $1,400. The second column of estimates shows that much of this variation disappears when the seven outliers are excluded from the analysis. The ranges of values in the two plant-sheds decline to roughly $700 (Metro) current user costs in the interceptor system.

Table 5

User Costs and Subsidies per 100Kgal by Municipality
Under a Uniform Fee Structure Covering Full System Costs

	Treatment Plants		Interceptors		Total	
	Cost	Subsidy	Cost	Subsidy	Cost	Subsidy
Total	114		9		123	
Metro	103	-10	9	0	112	-10
Andover	103	-10	17	8	121	-2
Anoka	103	-10	25	16	129	6
Arden Hills	103	-10	8	-1	111	-12
Birchwood Village	103	-10	7	-2	110	-13
Blaine	103	-10	17	7	120	-3
Brooklyn Center	103	-10	14	5	118	-5
Brooklyn Park	103	-10	20	11	123	0
Centerville	103	-10	21	11	124	1
Champlin	103	-10	17	8	121	-2
Circle Pines	103	-10	16	6	119	-4
Columbia Heights	103	-10	12	3	116	-7
Coon Rapids	103	-10	18	8	121	-2
Crystal	103	-10	16	6	119	-4
Edina	103	-10	10	0	113	-10
Falcon Heights	103	-10	6	-4	109	-14
Forest Lake C	103	-10	24	15	128	5
Forest Lake T	103	-10	24	14	127	4
Fridley	103	-10	14	4	117	-6
Gem Lake	103	-10	6	-3	110	-13
Golden Valley	103	-10	11	2	115	-8
Hilltop	103	-10	11	2	114	-9
Hopkins	103	-10	8	-1	112	-11
Hugo	103	-10	19	10	123	-0
Inver Grove Hgts	103	-10	5	-5	108	-15
Lake Elmo	103	-10	1	-8	104	-19
Landfall	103	-10	3	-7	106	-17
Lauderdale	103	-10	6	-3	110	-14
Lexington	103	-10	14	5	118	-6
Lilydale	103	-10	8	-1	112	-11
Lino Lakes	103	-10	18	9	121	-2
Little Canada	103	-10	11	2	114	-9
Mahtomedi	103	-10	8	-1	111	-12
Maple Grove	103	-10	16	7	119	-4
Maplewood	103	-10	8	-1	112	-11
Medicine Lake	103	-10	18	9	121	-2
Medina	103	-10	22	13	126	3
Mendota	103	-10	11	2	114	-9
Mendota Heights	103	-10	6	-3	110	-13
Minneapolis	103	-10	7	-2	111	-12
Mounds View	103	-10	15	5	118	-5
New Brighton	103	-10	17	8	121	-2
New Hope	103	-10	22	13	126	3
Newport	103	-10	5	-4	109	-14
North Oaks	103	-10	12	2	115	-8
North St. Paul	103	-10	5	-4	108	-15

Table 5 (cont.)

	Treatment Plants		Interceptors		Total	
	Cost	Subsidy	Cost	Subsidy	Cost	Subsidy
Stillwater	136	23	0	-9	136	13
Bayport	136	23	0	-9	136	13
Oak Park Heights	136	23	0	-9	136	13
Stillwater C	136	23	0	-9	137	14
Stillwater T	136	23	0	-9	136	13
Hastings	259	145	0	-9	259	136
Cottage Grove	185	71	0	-9	185	62
Chaska	194	81	0	-9	194	71
Rosemount	228	114	4	-6	232	109

Table 6

Plant and Interceptor Connection Costs by Municipality

	Plant Cost	Interceptor Cost	Total Cost	Subsidy*
System Average	708	269	977	---
Metro Average	685	353	1,038	61
Andover	685	291	976	-1
Anoka	685	447	1,132	155
Arden Hills	685	286	971	-6
Birchwood Village	685	118	803	-174
Blaine	685	393	1,078	101
Brooklyn Center	685	659	1,344	367
Brooklyn Park	685	301	986	9
Centerville	685	380	1,065	87
Champlin	685	204	889	-88
Circle Pines	685	237	922	-55
Columbia Heights	685	657	1,342	364
Coon Rapids	685	303	988	10
Crystal	685	515	1,200	222
Edina	685	496	1,181	203
Falcon Heights	685	297	982	5
Forest Lake C	685	445	1,130	153
Forest Lake T	685	430	1,115	138
Fridley	685	244	929	-48
Gem Lake	685	81	766	-212
Golden Valley	685	543	1,228	250
Hilltop	685	545	1,230	252
Hopkins	685	552	1,237	260
Hugo	685	369	1,054	77
Inver Grove Hgts	685	79	764	-213
Lake Elmo	685	63	748	-229
Landfall	685	65	750	-228
Lauderdale	685	565	1,250	272
Lexington	685	224	909	-69
Lilydale	685	457	1,142	164
Lino Lakes	685	343	1,028	50
Little Canada	685	173	858	-119
Mahtomedi	685	111	796	-182
Maple Grove	685	259	944	-34
Maplewood	685	336	1,021	43
Medicine Lake	685	774	1,459	482
Medina	685	799	1,484	507
Mendota	685	476	1,161	184
Mendota Heights	685	489	1,174	196
Minneapolis	685	475	1,160	182
Mounds View	685	275	960	-18
New Brighton	685	345	1,030	52
New Hope	685	698	1,383	405
Newport	685	96	781	-196
North Oaks	685	205	890	-87
North St. Paul	685	269	954	-24
Oakdale	685	188	873	-105
Osseo	685	73	758	-219
[illegible]	685	792	1,477	499

Table 6 (cont.)

	Plant Cost	Interceptor Cost	Total Cost	Subsidy*
Stillwater Average	1,075	1	1,076	99
Bayport	1,075	0	1,075	98
Oak Park Heights	1,075	0	1,075	98
Stillwater C	1,075	5	1,080	103
Stillwater T	1,075	0	1,075	98
Hastings	2,478	0	2,478	1,501
Cottage Grove	1,662	0	1,662	685
Chaska	1,523	0	1,523	546
Rosemount	513	54	567	-410

* Subsidy assumes a system-wide uniform SAC equal to the system average SAC cost.

Table 7

User Costs, Connection Costs and Subsidies per 100Kgal per year by Policy Areas Under a Uniform Fee Structure Covering Full System Costs

User Costs

	Treatment Plants		Interceptors		Total	
	Cost	Subsidy	Cost	Subsidy	Cost	Subsidy
Total	114		9		123	
Developed	105	-9	8	-1	113	-10
Developing	124	10	12	3	136	13
Free-standing	165	52	4	-5	169	47

Connection Costs

	Treatment Plants	Interceptors	Total	Subsidy
Total	708	269	977	0
Developed	670	439	1,109	132
Developing	644	246	889	-88
Free-standing	1,144	99	1,243	266

Reported data were rounded after totals and subsidies were computed. Columns or rows may not sum to totals.

Developing Area, the largest subsidies, as measured by the present value of the subsidy per household, tend to be coming from the two central cities and the inner-most suburbs. Falcon Heights and South St. Paul pay subsidies to the rest of the system with present values of about $800, for instance. In the Developing and Free-standing Growth Areas, the largest subsidies tend to be going to municipalities in the south-central and western parts of the region, as well as to the municipalities served by the four smallest plants. Places receiving subsidies with present values in excess of $1,500 include Apple Valley, Farmington, Lakeville, Long Lake, Maple Plain, Rosemount, Shakopee, Shorewood, Spring Lake, and Wayzata. Several other municipalities near Lake Minnetonka also show subsidies approaching this level.

The total dollar value of the subsidy coming out of the Developed Area amounts to roughly $6.32 million per year, with Minneapolis and St. Paul each absorbing about 40% of the cost -- $2.87 million and $2.77 million per year respectively. These amounts do not, of course, represent a very large percentage of their respective budgets. However, at the margin, such totals could represent significant opportunity costs to the region's two central cities. For instance, recently reported estimates place the extra costs associated with fully funding Head Start in Minneapolis at about $4.0 million per year. Another way to assess the magnitude of the numbers is to calculate the 20 year bond issue that the annual streams of money could support. In both cases, it is roughly $35 million at an interest rate of 6%.

Table 8 (cont.)

	Total Subsidy /100Kgal	Total Subsidy /H'hold	Present Value of /H'hold Subsidy	Total Subsidy
Developing Area (cont.)				
Lakeville	73.83	75.99	1,900	599,536
Landfall	-16.81	-13.47	-337	-3,866
Lexington	-5.34	-4.08	-102	-3,421
Lilydale	-11.24	-9.48	-237	-3,147
Lino Lakes	-1.66	-0.57	-14	-1,495
Little Canada	-8.50	-8.27	-207	-32,207
Long Lake	42.10	68.08	1,702	50,516
Mahtomedi	-11.38	-9.48	-237	-17,191
Maple Grove	-3.51	-3.58	-90	-44,840
Maple Plain	45.40	82.61	2,065	56,755
Maplewood	-11.27	-16.64	-416	-192,091
Medicine Lake	-1.51	-1.74	-44	-301
Medina	2.74	2.32	58	2,383
Mendota	-8.55	-27.35	-684	-684
Mendota Heights	-13.06	-19.75	-494	-65,440
Minnetonka	36.94	42.44	1,061	792,435
Minnetonka Beach	42.58	58.15	1,454	11,922
Minnetrista	42.07	28.16	704	35,338
Mound	40.99	46.54	1,164	172,577
Mounds View	-4.73	-4.85	-121	-22,749
Newport	-14.14	-11.42	-286	-15,273
North Oaks	-7.84	-1.25	-31	-1,332
North St. Paul	-14.41	-15.65	-391	-68,428
Oakdale	-12.40	-14.47	-362	-96,825
Orono	45.55	41.75	1,044	109,766
Osseo	-2.52	-2.32	-58	-2,292
Plymouth	1.47	2.18	54	39,651
Ramsey	4.59	0.38	9	1,378
Rosemount	108.92	90.14	2,254	249,421
Savage	14.75	19.71	493	64,614
Shakopee	30.43	64.06	1,602	267,207
Shoreview	-5.37	-5.55	-139	-50,205
Shorewood	41.74	83.49	2,087	167,808
Spring Park	37.54	62.65	1,566	46,548
St. Bonifacius	36.97	36.60	915	14,418
St. Paul Park	-13.35	-11.55	-289	-20,030
Tonka Bay	35.24	46.63	1,166	27,138
Vadnais Heights	-2.15	-2.36	-59	-9,142
Victoria	38.19	37.93	948	28,640
Waconia	42.33	39.79	995	55,871
Wayzata	37.10	66.21	1,655	113,157
White Bear Lake	-6.23	-6.43	-161	-58,403
White Bear T	-2.48	-2.69	-67	-8,764
Willernie	-11.18	-18.07	-452	-1,788
Woodbury	-14.81	-18.52	-463	-129,320
	46.65	60.30	1507	1,543,635
Free-standing				
Bayport	13.50	38.79	970	28,896
Chaska	71.38	101.96	2,549	425,397
[illegible]	[illegible]	6.59	165	14,540

developers and homeowners to use water-saving plumbing fixtures.

Second, higher consumption levels imply greater future capital investment for transporting and treating waste. Higher fees (and lower consumption) would effectively increase the capacity of the existing infrastructure (measured in numbers of users served) and lessen the need for new investment.

Finally, subsidizing consumption in this dimension effectively subsidizes the consumption of housing services in general. As a result, in the long run, the region as a whole will be less densely settled than it would be if fees corresponded to total costs. Lower density settlement patterns increase the cost of providing a whole range of public services, including (but not limited to) waste water collection and treatment, transportation, and education.

(2) User costs vary significantly across the region. A uniform fee structure sends inaccurate signals to consumers regarding the costs of development in different parts of the region. The cost variations our work discovered are great enough to affect settlement patterns in the region -- effects that would generate greater than optimal long run service and environmental costs. The overall magnitude of these effects is uncertain, given the relatively small share of sewer costs in total housing costs. However, the subsidies implicit in a uniform fee schedule are substantial in some parts of the region.

(3) A uniform fee designed to cover full costs would generate subsidies flowing from the inner part of the region to outer portions. (Similarly, the current fee distributes the savings from past federal aid only to users

costly plant (Hastings). The data also suggest that these economies in treatment are only partially offset by diseconomies in transporting waste. Unit costs for the Metro interceptor system are not substantially greater than those for the system's middle-sized plants. As a result, the total Metro system shows lower total unit costs than the other plant-sheds in the system.

B. <u>Plant and Interceptor Connection Fees</u>

The implications of our estimates of the costs of serving new users are less substantial than those for current-user costs. The general findings are that (1) the current Service Availability Charge or SAC is probably too low; and (2) the costs that the SAC offsets vary across the region.

(1) The implications of a lower than optimal connection fee are not overwhelming unless the costs of serving new users greatly exceed actual SAC fees. This does not appear to be the case at present. The average connection cost exceeds the actual fee by roughly $270. Given that the connection fee is a one-time cost, this difference is unlikely to have significant implications for the overall density of development in the region.

(2) The implications of connection cost variations are also unlikely to be substantial. The subsidies generated by a uniform fee are not likely to have large effects on settlement patterns for the same reason that a lower than optimal overall average will not. The differences are probably too small to translate into significant housing cost differentials.

Connection costs are lower, in general, at the newer plants which primarily serve outer portions of the region. Given that most new hook-ups are occurring in the outer parts of the region, the pattern of SAC subsidies should be offered only for significant losses. Those who suffer a minor loss are forced to content themselves with the fact that their small losses from one policy change will, over the long run, be compensated for by gains -- small and large -- from other policy changes.

We believe that few if any individuals or business firms would be significantly disadvantaged by adopting the policy changes we have proposed. Neither present nor our proposed price policies for waste-water treatment would bulk large in the decisions of households and most business firms.[48] When the MWCC switched in 1987 from a system in which fees differed among plant sheds to a uniform pricing system which disadvantaged the metropolitan area's developed area, it felt the change to be sufficiently consequential that it should be phased in over a five-year period rather than instituted in a single step. Changing to a system that would reverse this disadvantage to the developed area could be effected by a similar gradual procedure.

Where along an appropriate sink to locate a waste-water treatment plant is, to a degree, an arbitrary decision. This decision affects the distances between individual communities and the treatment plants which serve them and, hence, what they would pay under a distance-based pricing system for sewer collection. Similarly, changing where a new interceptor will be located in a way that would leave total system costs unchanged could have significant effects on the costs of collecting sewage from individual communities. If we understand correctly, such considerations played a significant role in the 1987 decision to shift to uniform pricing. It is not our prerogative to

"No." So, too, would the view that Lakes Harriet and Minnetonka are the property not of the surrounding communities but, rather, of the entire metropolitan area.

D. Legal and Management Issues

A switch to a cost-based fee structure raises several legal and management issues. The primary legal consideration arises from the fact that full-cost pricing would generate a surplus for the MWCC. It is our understanding that the current limit for MWCC surpluses is 7 percent of its total annual budget. Full-cost pricing would exceed this limit in most years. The primary objective of cost-based pricing is to generate accurate incentives regarding the use of the services involved. This principle would not be seriously compromised if part of any surplus were "returned" to consumers in the form of general tax relief. However, a "refund" policy that was based on flow and costs within the system would compromise the principle. Therefore, if a return mechanism is necessary, it is important that funds be redistributed to municipalities in ways other than subsidizing sewer services -- tax base per capita is one possibility; lump-sum refunds to individual consumers is another.[30]

---

[30] Concerns have also been raised regarding whether it is allowable under federal regulations for the MWCC to include the cost of assets purchased with federal funds in its fee determination. This seems unlikely since some federal grant programs that helped finance construction of treatment plants in the 1960s and 1970s actually required that local authorities build reserve funds for future construction by including grant-financed costs in fees. The MWCC was required to get a waiver in order to exclude these costs. If later grant programs prohibit including federal costs in fees, this clearly poses problems for the type of fee system implied by our work. The most logical solution would be to follow current MWCC practice and distribute any implied fee reduction uniformly through the system, i.e. independently of cost [illegible] of sending accurate signals with

findings regarding connection costs are not as compelling. Any changes in that dimension should be preceded by more careful analysis of the value and expected lifetimes of MWCC assets and more comprehensive and up-dated linkage of asset value information with the location and pipe characteristics data in the GIS system.

$x + x/2\alpha = (2\alpha + 1)x/2\alpha = n$ which implies $x = 2\alpha n/(2\alpha + 1)$.

A fraction, $1/(1 + 1/2\alpha) = 2\alpha/(1 + 2\alpha)$, of the capital investment in the machine is used up by the passage of calendar time; the remaining $(1/2\alpha)/(1 + 1/2\alpha) = 1/(1 + 2\alpha)$ wears out with use.

A plausible allocation of the machine's costs between user and access fees would be to have:

(a) each user year and the ultimate user of each unused but available user-year of capacity pay equally for depreciation that is related to the passage of time; and

(b) each user pay an annual fee for depreciation that depends on system use that is independent of either the current date or the user's date of entry into the system.[31]

For a machine the use of which increases linearly from 0 to 100% on the date at which it has completely depreciated, alternative values of α imply the following fractions of total capital costs belonging to category (a)--equal charges for a user year and to an ultimate user for an unused but available year of capacity:

α	Fraction of Capital Cost Allocated to Calendar Time
0%[32]	0%
25%	33.3%
50%	50%
75%	60%
100%	66.7%

[31] A machine for which depreciation is caused entirely by use would provide a number of user years that is independent of the pattern of use. The longer is the period of use, however, the greater is the fee per user year that would be required to cover the machine's capital costs. This pricing system does not include an appropriate penalty for late entering users. We are currently working on a system that would provide an efficient incentive to induce early entry.